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TABLE II.—Percentage of rural population having, on Jan. 1, 1921, local health service under whole-time county or district health officers—Continued.

State.	Rural population.	Rural population with local health service under direction of whole-time health officer.	Percentage of rural population with local health service under direction of whole-time health officer.
Maine.....	468,445	0	0
Maryland.....	580,239	0	0
Massachusetts.....	202,108	0	0
Michigan.....	1,426,852	0	0
Minnesota.....	1,335,532	0	0
Mississippi.....	1,550,497	115,875	7.47
Missouri.....	1,817,152	29,067	1.59
Montana.....	376,878	40,588	10.77
Nebraska.....	891,066	0	0
Nevada.....	62,153	0	0
New Hampshire.....	163,322	0	0
New Jersey.....	673,611	0	0
New Mexico.....	295,390	58,875	19.93
New York.....	1,794,985	0	0
North Carolina.....	2,068,753	715,390	34.58
North Dakota.....	557,446	0	0
Ohio.....	2,082,258	944,177	45.35
Oklahoma.....	1,488,803	19,435	1.31
Oregon.....	392,370	0	0
Pennsylvania.....	3,112,202	0	0
Rhode Island.....	15,217	0	0
South Carolina.....	1,359,737	253,476	18.24
South Dakota.....	531,675	0	0
Tennessee.....	1,726,659	0	0
Texas.....	3,150,539	188,138	5.97
Utah.....	233,812	0	0
Vermont.....	242,452	242,452	100
Virginia.....	1,635,203	253,023	15.47
Washington.....	607,886	151,949	24.99
West Virginia.....	1,094,694	26,242	2.39
Wisconsin.....	1,387,499	0	0
Wyoming.....	137,054	0	0
Total.....	51,394,295	4,245,482	8.23

The figures in this compilation, indicating that only 8.26 per cent of our rural population are provided with health service which even approaches adequacy, should be a matter of serious concern to all persons interested in our national welfare.

## A NOTE ON THE NATURAL IMMUNITY OF WILD RATS TO PLAGUE.

By R. R. SPENCER, Passed Assistant Surgeon, United States Public Health Service.

That a certain number of rats in the wild state possess natural immunity to bubonic plague is very certain. However, the approximate percentage of immunes has not been made clear, although several investigators have inoculated a series of wild rats to determine it. Unfortunately, the rodents so used were trapped in a known infected area or where a plague epizootic had recently occurred. The Indian Plague Commission,<sup>1</sup> using both the species *M.*

<sup>1</sup> Jour. of Hyg., Sept., 1906.

*norvegicus* and *M. rattus* from Bombay, showed that out of 580 rats experimentally inoculated 341, or 59 per cent, were alive after 14 days. These rats withstood the rubbing on scarified surfaces of emulsions of spleens of rats which had died of acute plague. They further showed that when inoculated with  $\frac{1}{5}$  to  $\frac{1}{10}$  agar tube of a culture, 3.7 per cent were immune; using  $\frac{1}{15}$  to  $\frac{1}{20}$  agar tube, 4.4 per cent were immune, and using  $\frac{1}{100}$  to  $\frac{1}{250}$  agar tube, 10.5 per cent were immune.

During the San Francisco plague epidemic, McCoy<sup>2</sup> inoculated rats cutaneously with tissue containing large numbers of *B. pestis* from plague-infected human beings, rats, or squirrels. About 15 per cent of small animals and about 50 per cent of large animals were found to be immune. It was thought that these rats had not been previously exposed to infection.

The following experiment was carried out during the fall of 1920, when various consignments of live rats were received at the plague laboratory at Pensacola, Fla., from Mobile, Ala. Mobile was selected because a careful post-mortem examination of over 4,200 rats had been made a few months before without finding a trace of plague infection, and also because no human cases have ever been reported from that port.

As shipments of rats were received, the animals were fed and permitted to rest for about 24 hours. Usually on the second day they were inoculated with plague. In all, 434 such rats were inoculated. Only 2 of these rats were of the species *M. rattus*; the remainder were *M. norvegicus*. Both of the species *M. rattus* succumbed to plague.

The cutaneous inoculations were from tissues of rats or guinea pigs dying of plague, and contained large numbers of organisms. Subcutaneous inoculations were usually from a 48-hour broth culture of *B. pestis*, using one-half cubic centimeter of a 1 : 10 and sometimes 1 : 20 dilution, depending upon the amount of growth in the tube. All rodents tabulated as having acute plague showed at least two of the five cardinal symptoms and the presence of morphologically typical organisms in the smears. All rats surviving 14 days or longer were killed and examined for evidence of plague.

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<sup>2</sup> The Rat and its Relation to the Public Health. Public Health Bulletin No. 30. 1910.

*Results of inoculating rodents with B. pestis.*

	Number.	Per cent.
<b>CUTANEOUS INOCULATION.</b>		
Acute plague.....	20	35.1
Resolving or chronic plague lesions.....	6	10.5
Negative for plague.....	25	43.8
Eaten or destroyed.....	6	10.5
Total rodents inoculated cutaneously.....	57	
<b>SUBCUTANEOUS INOCULATION.</b>		
Acute plague.....	204	54.1
Resolving or chronic plague lesions.....	31	8.2
Negative for plague.....	114	30.2
Eaten or destroyed.....	28	7.4
Total rodents inoculated subcutaneously.....	377	
<b>CUTANEOUS AND SUBCUTANEOUS INOCULATION.</b>		
Acute plague.....	224	51.6
Resolving or chronic plague lesions (13 died, 24 killed).....	37	8.6
Negative for plague.....	139	32.0
No diagnosis (eaten or destroyed).....	34	7.8
Total rodents inoculated.....	434	

**RESULTS OF INOCULATIONS.**

Cutaneous inoculations with plague, of 57 rats from a noninfected territory, showed 43.8 per cent to be immune.

Subcutaneous inoculation with plague, of 377 rats from a non-infected locality, showed 30.2 per cent to be immune.

A total of 434 rodents from a noninfected locality showed 32 per cent to be immune.

**CONCLUSION.**

A very considerable percentage of the wild *M. norvegicus* from a noninfected locality has been found to be immune to plague.

**VITAL STATISTICS, ENGLAND AND WALES, 1920.**

The following statements are taken from the "Quarterly Return of Marriages, Births, and Deaths Registered in England and Wales" (No. 288), issued by the Registrar General. The figures given are provisional and may differ slightly from revised figures to be presented later.

"According to the quarterly returns furnished by local registrars, 957,994 births and 466,213 deaths were registered in England and Wales in the year 1920. The natural increase of population, by excess of births over deaths, was, therefore, 491,781, the average annual increase in the preceding five years having been 187,625. This statement excludes all war deaths except those registered in this country. The number of persons married during the year was 759,316.